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idea that they have mastered geology; have they not recited so many weeks from a text-book? They have been misled. Education is more than a mere matter of the memory—a storing away of facts, as valuable as they may be; it is the cultivation of those powers by which the facts may be obtained at first hand. In this lies the training.

I am well aware of the excuse offered. Says the college president: "We do not pretend, nor do we care to make trained geologists; we wish to give our students an insight only into the science, that's all." Let me ask: How much chemistry worth the having can be obtained by reading or committing to memory the ordinary text-book? How much physics? How much biology? In a collegiate institution courses are offered in these branches for their *training* effect, without reference necessarily to the career of a student. Chemistry, physics and biology cannot, in these days, be taught without an equipment and teachers well versed in its management. Why should geology receive different treatment? Its demands are not less pressing and its educational value is fully as great. When the services of professionals can be obtained, why longer impose amateur instruction upon our students?

The root of the evil seems to lie not only in the want of a proper discrimination on the part of the patrons of educational institutions, but largely in the lack of a proper appreciation on the part of the authorities in charge. That more and louder protests have not been heard is strange. But the pace has been set. Those institutions which persist in offering cheap instruction, solely because it is cheap, must fall to the rear. That the best instruction will be given by the best trained teacher is axiomatic. Better by far that geology be not attempted than that it should be poorly presented; better that a curriculum be curtailed than that a study should be a source of weakness.

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ON A SUPPOSED IMMEDIATE EFFECT OF POLLEN.

TO THE EDITOR OF SCIENCE: I have been greatly interested in the account of a curious

freak in an apple tree given by Mr. T. H. Lennox in your issue of September 4, 1896, p. 317. After describing the freak, Mr. Lennox concludes that "there can be no reasonable doubt that the phenomenon arose from cross fertilization between pollen of the Talman Sweet and the ovule of the Greening." As some of the features of the case, as described by Mr. Lennox, seem to me opposed to such a conclusion, I venture the following suggestions:—

The apples on the northeast side of the tree, we are told, "were Rhode Island Greenings, such as the tree had always borne, while those on the southwest half of the tree were of a mixed character, *each apple being partly Greening and partly Talman Sweet.*" If the phenomenon is to be attributed to the direct action of the Talman Sweet pollen, it is difficult to understand why every apple on one half of the tree should be affected and none on the other half of the tree. As the pollen is normally carried by insects we should possibly expect a greater number of the fruits to be affected on the side toward the Talman Sweet tree than on the opposite side, but we should reasonably expect a portion of them to remain unaffected. We should also reasonably expect a few fruits on the opposite side of the tree to be similarly affected, as some of them would as surely be crossed with the Talman Sweet pollen as those on the side nearest the Talman Sweet tree. In other words, if this freak were due to cross pollination by insects with pollen of Talman Sweet, we should expect the fruits affected to be scattered irregularly over the tree, the majority being on the side adjoining the Talman Sweet tree. That the fruits on certain limbs or a certain part of the tree only should be affected and all of these similarly affected, is indeed difficult to explain as a result of cross pollination. One must necessarily presuppose a peculiar condition of this portion of the tree rendering possible the effect of the pollen described, as the other portion of the tree remains entirely unaffected. This is evidently Prof. Bailey's conclusion, as in his note following the article by Mr. Lennox he says: "Like heredity of mutilations it (the immediate effect of pollen) is rare and therefore apparently exceptional." Even when we assume some pecu-

liar condition of the limbs exhibiting the phenomenon the difficulty is not altogether passed, as we must still explain how it happens that all the flowers, which open quite irregularly, were pollinated with pollen from the same variety. Mr. Lennox himself calls attention to the difficulty in understanding why such results, if rightly due to the effect of pollen, as supposed, are not more common considering that cross pollination unquestionably occurs commonly in all orchards.

I am not familiar with the history of the varieties concerned and cannot suggest whether or not it is possible to consider this a reversion such as sometimes occurs late in the life of an individual. Partial reversion by segments in the same fruit, on certain limbs or the entire tree, is not of uncommon occurrence.\* Such stripes, further more, are evidently not necessarily due to reversion to characters derived from a cross, but frequently to characters lost by variation. It would seem to me not at all improbable, from the facts given, that this might be such a case of reversion in certain branches. It should be remembered in this connection that Darwin has given several cases of stripes on apples similar to the case in question, which cannot be explained as effects of cross pollination.† It is a common occurrence for oranges to produce segments of rind resembling lemon or citron, and these are commonly considered to be due to the immediate effect of pollination. These modified segments, however, are not infrequently found at considerable distances from lemon or citron trees, and they do not occur more frequently, so far as I have been able to observe, when branches of the orange and lemon are near together or interlocked. It is very probable that they are in most cases to be attributed to reversion. Occasionally navel fruits occur on almost all orange and lemon varieties and are commonly believed to be positive evidence of the immediate influence of navel pollen. Yet I have proven by numerous dissections that the navel is invariably formed early in the development of the pistil, weeks before it reaches the stage for pollination. It is well known that

certain varieties not navels more commonly produce navels than certain other varieties. On these varieties, again, the navel development may be found in some of the pistils long before pollination. The development of the navel is a profound morphological change originating early in the development of the pistil, and I think its production lies entirely outside the possibilities of pollen modification. Again: the absence of mature pollen in every navel anther examined by Prof. Van Deman and his assistants and myself makes it highly improbable that navel marks in oranges can ever be interpreted as due to the immediate effect of navel pollen. There is, unquestionably, a marked tendency among the various varieties of citrous fruits to sport in this way, and the isolated cases of navels on other varieties are merely illustrations of this tendency.

It is not impossible that a combination of the characters of two varieties on a portion of one tree, where two trees of the varieties concerned are growing quite near together as in the case described by Mr. Lennox, might be caused by graft hybridization produced by the fusion of roots from the different trees. I am not aware that any such case has ever been recorded or even suggested, but it is surely within the limits of possibility, as roots from different trees, which become closely associated or crowded together, sometimes fuse. I have observed in one case a fusion of two orange roots from different trees and have not infrequently observed the fusion of roots from the same tree. It is probable, however, that the case described by Mr. Lennox could not thus be explained, as I suppose the trees concerned were grafted on other roots. I presume Mr. Lennox is sure that the stock, on which the Greening is grafted, is in no way related to the Talman Sweet or any similar variety, and has never been 'double-worked,' that is, grafted twice with possibly a section of Talman Sweet remaining in the trunk. These are suggested as details which one must know positively before excluding their possible action.

The immediate effect of pollen is a much disputed question in horticulture, and one which demands the most careful experimental evidence to satisfactorily confirm. That there is

\* See Darwin, *Animals and Plants under Domestication*, II., p. 10. et. seq.

† l. c., I., p. 425.

some doubt as to whether the case described by Mr. Lennox can be considered an immediate effect of cross pollination, I think everyone critically examining it will admit. If due to reversion, graft hybridization or cross pollination, the same characters will probably appear on the tree again next year, so that further studies may be made. It is to be hoped that Mr. Lennox will be able to test the validity of his conclusions experimentally.

Horticultural literature has become so filled with descriptions of supposed cases of the immediate action of pollen where insufficient evidence is given to enable one to judge the merits of the case, that it behooves observers to be exceptionally careful in regard to all conditions if any final conclusions are to be reached.

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#### THE DEFINITION OF CIVIL ENGINEERING.

THERE is an error in my paper on the Artistic Element in Engineering which I should like to correct. Following the lead of other writers, I have ascribed the classic definition of civil engineering to Telford instead of to Tredgold, whom I have recently learned was its author. See *R. R. Gazette* of December 28, 1894, page 883, or of August 28, 1896, page 602.

I am indebted to Mr. H. G. Prout, of the *Gazette*, for calling my attention to the matter.

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#### SCIENTIFIC LITERATURE.

*Studies of Childhood.* JAMES SULLY. New York, D. Appleton & Co. 1896.

This book is a series of topical or classified studies of certain phases of the psychology of child life, covering, upon the whole, the period of life from two to six years of age, with quite a marked preference for those phenomena which dawn or are at their height in the second and third years. The topics covered are: The imagination of childhood; its reasonings, including a study both of the process and the more marked and characteristic processes; the beginnings of language; the emotion of fear; some phenomena of morality, including a study

of children's egoism, altruism, lies, and an account of their reactions to the moral injunctions of their elders; and a study of the child's æsthetic nature as manifested in his instinctive expressions and in his primitive drawings. The book concludes with a detailed individual study (covering about 100 pages) of one of his own children; and a very interesting study of the childhood of George Sand, drawn from the latter's autobiography. In this connection it may be remarked that a distinct feature of the book is not only the author's own style, which is literary rather than 'scientific,' but his wide acquaintance with autobiographical allusions to childhood and his apt use of such reminiscences. Ruskin, Dickens, Quinet, Tolstoi, Stevenson and many others figure in these pages.

This topical character of the treatment practically makes any synopsis of the book, beyond such a bare scheduling of headings, out of the question. An immense number of relevant observations of childhood, gathered from practically all available sources, supplemented by Mr. Sully's own observations, and enlivened by judicious remarks upon the salient qualities of childhood, make the book what it is. The hypercritical will probably conceive that the running commentary is sometimes discursive, occasionally dangerously near the padding point, and frequently of no great importance. But I confess myself sufficiently grateful in finding a book to review which is interesting to read as well as technically instructive.

The impossibility of summarizing the material content of the book makes it advisable to direct attention to the method, both what Mr. Sully himself says about method and that which he actually employs. As to the former, Mr. Sully devotes considerable space in his introduction to the objects and difficulties of child study, and to an account of the equipment necessary for observation and interpretation. The interest in child-study he finds to be partly due to the general development of natural science and partly to specifically psychological needs. The infant is, so to speak, more obviously a natural phenomenon than the adult; and the evolutionist in particular finds in him obvious signs of close kinship with the animal world, both in the foetal and early post-foetal stages. The